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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/806,118	03/23/2004	Edward Hurley	INTEL-0069	2131

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EXAMINER	
BEVERIDGE, RACHEL E	

ART UNIT	PAPER NUMBER
1725	

DATE MAILED: 09/25/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/806,118	Applicant(s) HURLEY ET AL.	
	Examiner Rachel E. Beveridge	Art Unit 1725	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 08 September 2006.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-17 and 31-43 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-17 and 31-43 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-14 and 37-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sreeram et al. (US 6,653,741 B2) in view of Totino et al. (US 2002/0079355 A1).

With respect to claims 1-12, 14, and 37-41, Sreeram discloses a "substrate" referring to a semiconductor and/or a heat sink component and/or any other article, device, or apparatus, etc. which is joined to another with a thermal interface material (TIM) (Sreeram, col. 3, lines 27-30). Sreeram also discloses the TIM should bond to the substrate at a temperature less than the failure temperature of the active electronic device (col. 3, lines 31-33) and that the solder melts and wets the substrate to allow the formation of a chemical and/or mechanical bond between the TIM and the substrate when solidified (col. 3, lines 35-38). Sreeram discloses that the TIM preferably does not require extrinsic fluxing (col. 4, lines 36-39). Sreeram states that the solder melts and wets the substrate to allow the formation of a chemical and/or mechanical bond between the TIM and the substrate when solidified (col. 3, lines 35-38). Sreeram discloses "pre-wetting" the components to ensure bonding with the bonding component during reflow (col. 7, lines 42-44). Sreeram discloses active solder and TIM's that can

wet non-metallic surfaces, such as Au, Au/Ni, and Ni (col. 5, lines 58-59). Sreeram discloses materials that enhance the thermal conductivity of the component, such as silver, copper, and gold (col. 3, lines 63-66). Sreeram discloses that these metals typically have relatively high melting temperatures (col. 3, lines 66-67). Also, Sreeram states that chemical fluxing is used when attempting to join items with conventional solders at temperatures below about 300° (col. 4, lines 26-28). Sreeram discloses active solder comprising indium (col. 5, lines 5-6). Sreeram discloses a heat sink or a heat spreader made of copper and/or aluminum components (col. 1, lines 14-15). Sreeram discloses knowledge in the art regarding reflowing so that the solder melts and wets by surface tension and/or local surface alloying; therefore, the interfaces of the components are intermetallic or interdiffused metals (col. 1, lines 51-55). Sreeram teaches heating the TIM until molten and then contacting the substrate and allowing it to cool, solidify and bond (col. 7, lines 20-24). Furthermore, Sreeram states that the solder melts and wets the substrate to allow the formation of a chemical and/or mechanical bond between the TIM and the substrate when solidified (col. 3, lines 35-38). However, Sreeram lacks disclosure of a vacuum chamber with an inert environment under vacuum conditions. Totino discloses introducing the assembly into a "controlled-atmosphere" chamber, such as a vacuum chamber (10) with means of heating (11). (Totino, p.2, ¶ 0020, lines 1-4). Totino also discloses controlling the atmosphere in the chamber (10) by forming a vacuum in the chamber or replacing the atmosphere in the chamber with an inert gas (p.2, ¶ 0021, lines 1-4). Furthermore, Totino discloses applying mechanical plating pressure on the assembly before and/or during reheating

(p.2, ¶ 0029, lines 1-3). Totino discloses applying mechanical plating pressure on the assembly before and/or during reheating (Totino, p.2, ¶ 0029, lines 1-3). Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the invention of Sreeram to include the vacuum chamber with inert gas atmosphere and pressure of Totino in order to establish a mechanical link between the layers (Totino, p.1, ¶ 0011, lines 6-7), enhance the strength of the bonding process (Totino, p.1, ¶ 0013, lines 1-2), and so that the support and coating are tightened against each other to compress the brazing material (Totino, p.2, ¶ 0029, lines 3-5).

With respect to claim 13, Totino discloses the vacuum at a "fairly high" pressure so that the residual pressure in the chamber is less than 10^{-4} mbar, typically between 10^{-4} and 10^{-5} mbar (Totino, p.1, ¶ 0016, lines 1-5). Put another way, Totino teaches the fairly high vacuum pressure to be an art recognized result effective variable depending on the type of material to be used. It would have been obvious to one having ordinary skill in the art at the time of the invention was made to modify the invention of Sreeram to include the fairly high pressure of Totino in order to avoid contamination of the assembly and/or possible pollution by the gas of the controlled atmosphere to prevent weakening of the metallic solder at the heating temperature (Totino, p.1-2, ¶ 0016, lines 5-10). That is it would have been obvious to one of ordinary skill in the art at the time of the invention to choose the instantly claimed ranges through process optimization, since it has been held that there are general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. See <u>In re Boesch</u>, 205 USPQ 215 (CCPA 1980).

Claims 1-14 and 37-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sreeram et al. (US 6,653,741 B2) in view of Mizuishi et al. ("Fluxless and Substantially Voidless Soldering for Semiconductor Chips," IEEE 38th Components Conference Proceedings) hereinafter referred to as "Mizuishi".

With respect to claim 1-12, 14, and 37-41, Sreeram discloses preparing a bonding surface of a heat dissipating member (Sreeram et al., col. 3, lines 27-30); bonding a thermal interface material layer including a metallic solder to the bonding surface, the thermal interface material layer to thermally couple the heat dissipating member to a heat conducting component by an impermanent attachment (col. 3, lines 31-33 and 35-38) [claim 1]. Sreeram discloses bonding thermal interface material achieved without using solder flux (col. 4, lines 36-39) [claim 2], and bonding of the thermal interface material comprising forming an intermetallic bond (col. 3, lines 35-38) [claim 3]. Sreeram also discloses preparing the bonding surface comprising plating the bonding surface with at least one wetting layer (col. 7, lines 42-44) [claim 4], and the wetting layer comprising gold (Au) or Nickel (Ni) (col. 5, lines 58-59) [claim 5]. Sreeram discloses the metallic solder having a melting point that is greater than the operating temperature of the heat conducting component (col. 3, lines 63-67 and col. 4, lines 1-2, 26-28) [claim 6]. Sreeram discloses metallic solder comprising of indium or an alloy thereof (col. 5, lines 5-6) [claim 7], and a heat dissipating member comprising of copper or aluminum (col. 1, lines 14-15) [claim 8]. Furthermore, Sreeram discloses reflowing the metallic solder on at least a portion of the bonding surface to form a liquid metallic

solder layer (col. 1, lines 51-55 and col. 7, lines 20-24), and allowing the liquid metallic solder layer to cool to a temperature of less than the melting point of the metallic solder (col. 3, lines 35-38) [claim 9]. Sreeram discloses heating the metallic solder to a temperature of greater than or equal to the melting point of the metallic solder to form the liquid metallic solder (col. 3, lines 63-67 and col. 4, lines 1-2 and 26-28), and disposing the liquid metallic solder on at least a portion of the bonding surface to form a liquid metallic solder (col. 1, lines 51-55 and col. 7, lines 20-24) [claim 10]. Sreeram also discloses allowing the liquid metallic solder layer to cool to a temperature of less than the melting point of the metallic solder (col. 3, lines 35-38) [claim 14], bonding including providing the liquid metallic solder on the bonding surface (col. 1, lines 51-55 and col. 7, lines 20-24) [claim 39], and bonding further including the liquid metallic solder layer to cool (col. 3 lines 35-38) [claim 41]. However, Sreeram lacks disclosure of a vacuum chamber with an inert environment under vacuum conditions. Mizuishi discloses bonding including proving the solder perform (in between a semiconductor chip and heat sink) in a vacuum chamber under vacuum conditions and heating the material in the vacuum chamber to form liquid metallic solder (Mizuishi et al., "Experimental Procedures," p. 330, col. 2) [claim 1]. Mizuishi discloses a fluxless solder ("Experimental Procedures," p. 331, col. 1) [claim 2], reflowing the metallic solder on the bonding surface to form liquid metallic solder layer, and allowing the liquid metallic solder to cool to a temperature of less than the melting point of the metallic solder (p. 330, col. 2) [claim 9]. Mizuishi also discloses placing the metallic solder perform and the heat dissipating member into the vacuum chamber (p. 330, col. 2), placing the

vacuum chamber under vacumm conditions (p. 330, col. 2), and disposing the liquid metallic solder on at least a portion of the bonding surface to form a liquid metallic solder layer (p. 330, col. 2) [claim 10]. Mizuishi discloses providing a first inert environment in the vacuum chamber after placing the vacuum chamber under vacuum conditions (p. 330, col. 2) [claim 11], and providing a pressure environment in the vacuum chamber after placing the vacuum chamber under vacuum conditions (p. 330, col. 2 and p. 331, col. 1 and 2; more particularly, "dry nitrogen gas") [claim 12]. Mizuishi also discloses removing at least a portion of the second pressure environment from the vacuum chamber (p. 330, col. 2 and p. 331, col. 1) [claim 14]. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the invention of Sreeram to include the vacuum soldering process of Mizuishi in order to effectively bond a semiconductor to a heat sink and avoid oxidation and voids in the bonds (Mizuishi et al., p. 330, col. 1).

With respect to claim 13, Mizuishi discloses the pressure environment at about 775 torr (near 760 torr = 15 psi). It is the examiner's position that the amounts in question are so close that is it prima facie obvious that one skilled in the art would have expected them to have the same properties. *Titanium Metals Corp. v. Banner*, 227 USPQ 773. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the invention to modify the invention of Sreeram to include the vacuum soldering process of Mizuishi in order to effectively bond a semiconductor to a heat sink and avoid oxidation and voids in the bonds (Mizuishi et al., p. 330, col. 1).

Claims 15-17 and 42-43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sreeram et al. (US 6,653,741 B2) in view of Totino et al. (US 2002/0079355 A1).

Sreeram discloses a "substrate" referring to a semiconductor and/or a heat sink component and/or any other article, device, or apparatus, etc. which is joined to another with a thermal interface material (TIM) (Sreeram, col. 3, lines 27-30). Sreeram also discloses the TIM should bond to the substrate at a temperature less than the failure temperature of the active electronic device (col. 3, lines 31-33) and that the solder melts and wets the substrate to allow the formation of a chemical and/or mechanical bond between the TIM and the substrate when solidified (col. 3, lines 35-38). Sreeram discloses materials that enhance the thermal conductivity of the component, such as silver, copper, and gold (Sreeram, col. 3, lines 63-66) and discloses that these metals typically have relatively high melting temperatures (col. 3, lines 66-67). Also, Sreeram states that chemical fluxing is used when attempting to join items with conventional solders at temperatures below about 300° (col. 4, lines 26-28). Sreeram discloses knowledge in the art regarding reflowing so that the solder melts and wets by surface tension and/or local surface alloying; therefore, the interfaces of the components are intermetallic or interdiffused metals (col. 1, lines 51-55). Sreeram teaches heating the TIM until molten and then contacting the substrate and allowing it to cool, solidify and bond (col. 7, lines 20-24). Sreeram discloses that the TIM preferably does not require extrinsic fluxing (col. 4, lines 36-39). Sreeram discloses Nickel particles as thermally

conductive non-fusible fillers (Sreeram, p.2, ¶ 0021, lines 5-8). However, Sreeram lacks disclosure of a vacuum chamber with an inert environment under vacuum conditions. Totino discloses introducing the assembly into a "controlled-atmosphere" chamber, such as a vacuum chamber (10) with means of heating (11) (Totino, p.2, ¶ 0020, lines 1-4). Totino also discloses controlling the atmosphere in the chamber (10) by forming a vacuum in the chamber or replacing the atmosphere in the chamber with an inert gas (p.2, ¶ 0021, lines 1-4). Furthermore, Totino discloses applying mechanical plating pressure on the assembly before and/or during reheating (p.2, ¶ 0029, lines 1-3). Totinio also discloses the possibility of avoiding contamination of the elements of the assembly and/or possible pollution by the gas of the controlled atmosphere, which may be, for example, oxygen contained in the industrial gases (p.1-2, ¶ 0016, lines 5-10). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the invention of Sreeram to include the vacuum chamber with inert gas atmosphere and pressure of Totino in order to establish a mechanical link between the layers (Totino, p.1, ¶ 0011, lines 6-7), enhance the strength of the bonding process (Totino, p.1, ¶ 0013, lines 1-2), and so that the support and coating are tightened against each other to compress the brazing material (Totino, p.2, ¶ 0029, lines 3-5).

Claims 15- 17 and 42-43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sreeram et al. (US 6,653,741 B2) in view of Mizuishi et al. ("Fluxless and Substantially Voidless Soldering for Semiconductor Chips," IEEE 38th Components Conference Proceedings) hereinafter referred to as "Mizuishi".

Sreeram discloses placing a metallic solder and a heat dissipating member having a bonding surface in a chamber (Sreeram et al., col. 3, liens 27-30), heating the metallic solder to a temperature greater than or equal to the melting point of the metallic solder to form a liquid metallic solder (col. 3, lines 63-67 and col. 4, lines 1-2, 26-28), disposing the liquid metallic solder on at least a portion of the bonding surface to form a liquid metallic solder layer (col. 1, lines 51-55 and col. 7, liens 20-24), and allowing the liquid metallic solder layer to cool to a temperature of less than the melting point of the metallic solder (col. 3, lines 35-38) [claim 15]. Sreeram discloses a metallic solder comprising a fluxless metallic solder (col. 4, lines 36-39) [claim 16], and a wetting layer including gold or nickel plating (col. 5, lines 58-59) [claim 17]. However, Sreeram lacks disclosure of a vacuum chamber with an inert environment under vacuum conditions. Mizuishi discloses a placing the metallic solder and a heat dissipating member having a bonding surface into a vacuum chamber (Mizuishi et al., p. 330, col. 1, "Introduction"; and p. 330, col. 2), placing the vacuum chamber under vacuum conditions (p. 330, col. 2 and p. 331, col. 2), heating the metallic solder (p. 330, col. 2), providing a pressurized inert atmosphere in the vacuum chamber (p. 331, col. 1 and 2), disposing the liquid metallic solder on the bonding surface to form a liquid metallic solder layer (p. 330, col. 2), removing at least a portion of the pressurized inert atmosphere from the vacuum chamber (p. 330, col. 2 and p. 331 "process"), allowing the liquid metallic solder layer to cool (p. 330, col. 2 and p. 331, col. 1) [claim 15]. Mizuishi also discloses fluxless metallic solder (p. 331, col. 1) [claim 16], and providing the wetting layer on the bonding surface prior to placing the heat dissipating member into the vacuum chamber (p. 330,

col. 2, see step 1) [claim 17]. Furthermore, Mizuishi discloses placing the vacuum chamber under vacuum conditions including removing a portion of the initial atmosphere from the vacuum chamber (p. 330, col. 2 and p. 331, col. 2) [claim 42], and removing the portion of the initial atmosphere includes removing oxygen gas from the vacuum chamber (p. 331, col. 1) [claim 43]. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the invention Sreeram to include the vacuum soldering process of Mizuishi in order to effectively bond a semiconductor to a heat sink and avoid oxidation and voids in the bonds (Mizuishi et al., p. 330, col. 1).

Claims 31-36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sreeram et al. (US 6,653,741 B2) in view of Mizuishi et al. ("Fluxless and Substantially Voidless Soldering for Semiconductor Chips," IEEE 38th Components Conference Proceedings) hereinafter referred to as "Mizuishi".

Sreeram discloses proving a metallic solder (Sreeram et al. col. 3, lines 31-33 and 35-38), heating the metallic solder to at least a melting temperature of the metallic solder (col. 3, lines 63-67 and col. 4, lines 1-2, 26-28), and allowing the heated metallic solder to cool to a temperature less than the melting point of the metallic solder (col. 3, lines 35-38) [claim 31]. Sreeram also discloses providing the heated metallic solder onto the bonding surface including bonding the heated metallic solder to the bonding surface without a solder flux (col. 4, lines 36-39) [claim 36]. However, Sreeram lacks disclosure of a vacuum chamber with an inert environment under vacuum conditions.

Mizuishi discloses providing a metallic solder in a vacuum chamber under vacuum conditions (Mizuishi et al., p. 330, col. 2), heating the metallic solder to at least a melting temperature of the metallic solder while in the vacuum chamber (p. 330, col. 2), proving a pressurized inert atmosphere in the vacuum chamber while the metallic solder is in the vacuum chamber (p. 330, col. 2 and p. 331, col. 1 and 2), providing the heated metallic solder onto a bonding surface while the metallic solder is in the vacuum chamber (p. 330, col. 2), and allowing the heated metallic solder to cool (p. 330, col. 2) [claim 31]. Mizuishi also discloses the inert atmosphere comprising nitrogen gas (p. 331, col. 2) [claim 32], providing the metallic solder in the vacuum chamber under vacuum conditions including removing a portion of the initial atmosphere from the vacuum chamber (p. 330, col. 2) [claim 33], and removing a portion of the initial atmosphere including removing an amount of oxygen gas from the vacuum chamber (p. 331, col. 1) [claim 34]. Furthermore, Mizuishi discloses removing at least a portion of the inert atmosphere from the vacuum chamber (p. 331, col. 2) [claim 35], and providing the heated metallic solder onto the bonding surface including bonding the heated metallic solder to the bonding surface without solder flux (p. 331, col. 1) [claim 36]. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the invention of Sreeram to include the vacuum soldering process of Mizuishi in order to effectively bond a semiconductor to a heat sink and avoid oxidation and voids in the bonds (Mizuishi et al., p. 330, col. 1).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Rachel E. Beveridge whose telephone number is 571-272-5169. The examiner can normally be reached on Monday through Friday, 9 am to 6 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Ryan can be reached on 571-272-1292. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

reb
September 20, 2006

JONATHAN JOHNSON
PRIMARY EXAMINER